

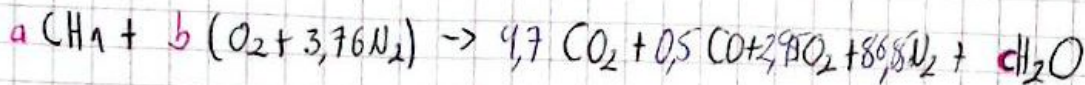
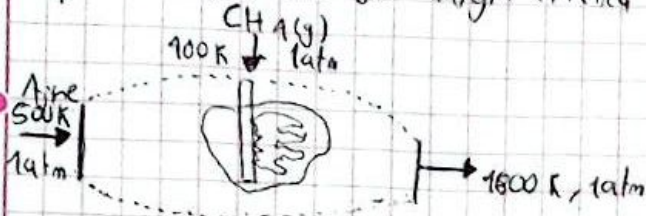
Taller Corte 3

Día

Mes

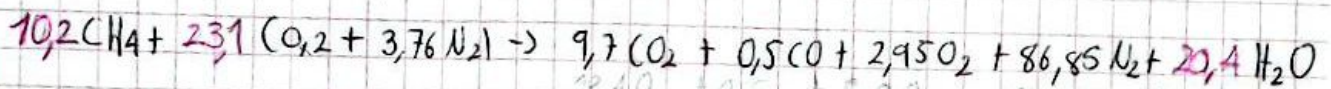
Año

- 1) Gas metano a 400 K y 1 atm entra a una cámara de combustión, donde se mezcla con aire que entra a 300 K y 1 atm. Los productos de combustión salen a 1800 K y 1 atm y el análisis de los mismos es base seca: CO_2 9,7%, CO 0,5%, O_2 2,95% y N_2 86,85%. Para operación en estado estable el valor promedio del calor específico c_p del metano entre 298 y 400 K es 38 KJ/(kmol.K). Desprecie los efectos de energía cinética y potencial.



$$\begin{aligned} \text{C: } & 9,7 + 0,5 = a \\ \text{H: } & 2c = 4a \\ \text{O: } & (9,7)(2) + (0,5) + 2(2,95) + c = 2b \end{aligned}$$

$$a = 10,2 \quad b = 23,1 \quad c = 20,4$$



$$10,2 \times 4 = 40,8 = 20,4 \times 2$$

$$9,7 \times 2 + 0,5 + 2 \times 2,95 + 20,4 = 46,2 = 23,1 \times 2$$

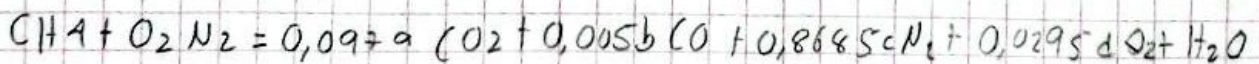
	n_i	h_f°	$h_f^\circ + \Delta h^\circ$
CH_4	10,2	-74,85	
O_2	23,1	0	
N_2	86,85	0	
CO_2	9,7	-393,5	-393,5 + 40286
CO	0,5	-110,52	-110,52 + 29919
O_2	2,95	0	0 + 3992
N_2	86,85	0	0 + 29838
H_2O	20,4	-241,8	-241,8 + 34760

Tabla B-8

	CO_2	CO	O_2	N_2	H_2O
100	2,90	2,19	3,20	2,19	2,54
127	4,0285	2,9219	3,088	2,9838	3,4369
200	7,08	5,16	5,31	5,13	6,01

$$\dot{Q}_{cv} = \dot{h}_p - \dot{h}_R = \left[0,951(\dot{h}_f^\circ + \Delta h^\circ)_{\text{CO}_2} + 0,049(\dot{h}_f^\circ + \Delta h^\circ)_{\text{CO}} + 0,299(\dot{h}_f^\circ + \Delta h^\circ)_{\text{O}_2} + 8,515(\dot{h}_f^\circ + \Delta h^\circ)_{\text{N}_2} + 2(\dot{h}_f^\circ + \Delta h^\circ)_{\text{H}_2\text{O}} \right] - \left[\dot{h}_f^\circ + \Delta h^\circ \right]_{\text{CH}_4} + 2,265(\dot{h}_f^\circ + \Delta h^\circ)_{\text{O}_2} + 8,515(\dot{h}_f^\circ + \Delta h^\circ)_{\text{N}_2}$$

$$\dot{Q}_{cv} = (\dot{h}_f + \dot{c}_p \Delta T)$$



$$\text{C} \rightarrow 1 = (0,097 + 0,005) \times \rightarrow 1/0,102 = x = 9,8039 = x$$

$$\rightarrow \text{CO}_2 = 0,097x = 0,951 \rightarrow \text{O}_2 = 0,0295x = 0,289, \text{CO} = 0,005x = 0,049, \text{N}_2 = 0,8685x = 8,515$$

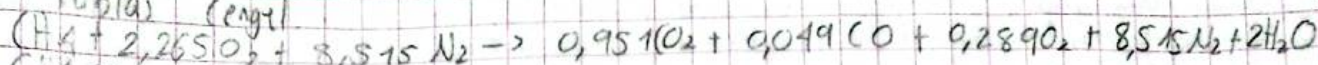
$$\text{CH}_4 + 2,2666 \text{O}_2 + 8,5146 \text{N}_2 = 0,95098 \text{CO}_2 + 0,049019 \text{CO} + 8,5146 \text{N}_2 + 0,2992 \text{O}_2 + 2 \text{H}_2\text{O}$$

Día

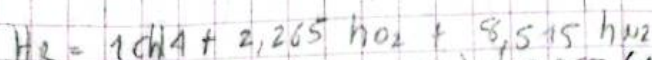
Mes

Año

Tabla Cengel


C₁A₁C₂P

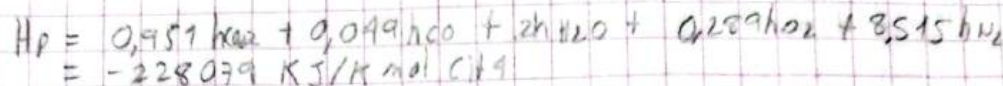
Reactivos



$$= -74850 + 38(400 - 298) + 2,265(14770 - 8662) + 8,515(1581 - 8669)$$

$$= -6844 \text{ KJ/Kmol CH}_4$$

Productos



$$= -228079 \text{ KJ/Kmol CH}_4$$

$$\text{H}_2 = 0,951(-393520) + 0,049(-110530) + 2(-241820) + 0,289(6031) + 8,515(57651 - 8669)$$

$$\text{h}_2 = -228079 \text{ KJ/Kmol CH}_4$$

$$\text{h}_2 - \text{h}_1 = -228079 \text{ KJ/Kmol} - (-6844 \text{ KJ/Kmol})$$

$$= -221235 \text{ KJ/Kmol CH}_4$$

2.

atm
→ 25

→ T

Subs

a

b

c

d

O₂

25,48

1,520 × 10⁻²

-0,7155 × 10⁻⁵

1,5212 × 10⁻⁹

N₂

29,4

-0,57 × 10⁻²

0,409 × 10⁻⁵

-2873 × 10⁻⁹

CO₂

22,6

5,981 × 10⁻¹²

-3,51 × 10⁻⁵

7,469 × 10⁻⁹

H₂O

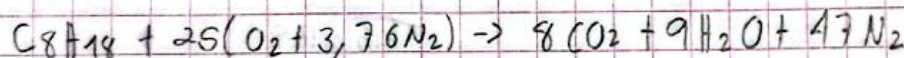
32,4

0,1923 × 10⁻²

1,055 × 10⁻⁵

-3545 × 10⁻⁹

Combustion completa NO sale Oxigeno



$$\text{Cp CO}_2 = 22,26 + 5,981 \times 10^{-2} T - 3,501 \times 10^{-5} T^2 + 7,469 \times 10^{-9} T^3$$

$$\text{Cp H}_2\text{O} = 32,24 + 0,1923 \times 10^{-2} T + 1,055 \times 10^{-5} T^2 - 3,545 \times 10^{-9} T^3$$

$$\text{Cp N}_2 = 28,90 - 0,1571 \times 10^{-2} T + 0,8081 \times 10^{-5} T^2 - 2,873 \times 10^{-9} T^3$$

C₈H₁₈

T₁

h₁

$$\rightarrow \text{h}_f = -249910 \text{ KJ/Kmol}$$

O₂

12,5

h_f + Δh₀

N₂

47

h_f + Δh₀

CO₂

8

h_f + Δh₀

H₂O

9

h_f + Δh₀

N₂

47

h_f + Δh₀

$$\text{h}_f = -393520 \text{ KJ/Kmol}, \text{h}_a \text{ Tref} = 9364 \text{ KJ/Kmol}$$

$$\text{h}_f = -241820 \text{ KJ/Kmol}, \text{h}_a \text{ Tref} = 9904 \text{ KJ/Kmol}$$

$$\text{h}_a = \text{Tref} = 8669 \text{ KJ/Kmol}$$

$$\sum n_i \text{h}_{i,p} = \sum n_i \text{h}_{i,p} = \sum n_i \text{h}_{i,r}$$

$$\rightarrow \sum n_i \Delta \text{h}_p = (-249910) - (18(-393520) + 9(-241820)) \rightarrow \sum n_i \Delta \text{h}_p = 5074630 \text{ KJ/Kmol C}_8\text{H}_{18}$$

T_{fract} temp

Con 2000 K

$$\text{CO}_2 \rightarrow \text{h} = 100804 \text{ KJ/Kmol}$$

$$\text{H}_2\text{O} \rightarrow \text{h} = 82593 \text{ KJ/Kmol}$$

$$\text{N}_2 \rightarrow \text{h} = 64810 \text{ KJ/Kmol}$$

Con 3000 K

$$\text{CO}_2 \rightarrow \text{h} = 16222 \text{ KJ/Kmol}$$

$$\text{H}_2\text{O} \rightarrow \text{h} = 82593 \text{ KJ/Kmol}$$

$$\text{N}_2 \rightarrow \text{h} = 64810 \text{ KJ/Kmol}$$

$$8(100804 - 9364) + 9(82593 - 9904) + 47(64810 - 8669)$$

$$= 4024583 \text{ KJ/Kmol C}_8\text{H}_{18}$$

$$\sum n_i \Delta \text{h}_p = \text{Int}(\text{h}_{p, \text{fract}}) = 2000 \rightarrow 4024583$$

$$300 \rightarrow 6719057$$

$$\sum n_i \Delta \text{h}_p = 6719057 \text{ KJ/Kmol C}_8\text{H}_{18}$$

Día

Mes

Año

Con 2400 K

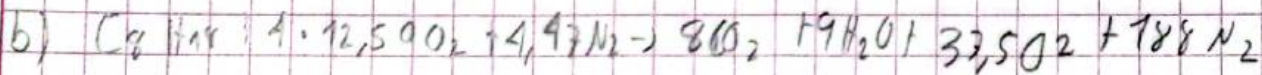
 $\text{CO}_2 \rightarrow h = 125152 \text{ KJ/Kmol}$ $\text{H}_2\text{O} \rightarrow h = 103508 \text{ KJ/Kmol}$ $\text{N}_2 \rightarrow h = 79370 \text{ KJ/Kmol}$

$$\left. \begin{array}{l} \text{CO}_2 \rightarrow h = 125152 \text{ KJ/Kmol} \\ \text{H}_2\text{O} \rightarrow h = 103508 \text{ KJ/Kmol} \\ \text{N}_2 \rightarrow h = 79370 \text{ KJ/Kmol} \end{array} \right\} \sum h_i \Delta h_i = 5079337 \text{ KJ/Kmol } \text{C}_8\text{H}_{18}$$

Interpolación

2400 $\rightarrow$ 50893372350 $\rightarrow$ 49551635074630 $\rightarrow$ 2374,52

a) $T_p = 2374,52 \text{ K}$



$$\sum h_i h_{ip} = 5074630 \text{ KJ/Kmol } \text{C}_8\text{H}_{18}$$

Con 900 K

 $\text{CO}_2 \rightarrow h = 40197 \text{ KJ/Kmol}$ $\text{H}_2\text{O} \rightarrow h = 34247 \text{ KJ/Kmol}$ $\text{O}_2 \rightarrow h = 299,90 \text{ KJ/Kmol}$ $\text{N}_2 \rightarrow h = 28820 \text{ KJ/Kmol}$

$$\left. \begin{array}{l} \text{CO}_2 \rightarrow h = 40197 \text{ KJ/Kmol} \\ \text{H}_2\text{O} \rightarrow h = 34247 \text{ KJ/Kmol} \\ \text{O}_2 \rightarrow h = 299,90 \text{ KJ/Kmol} \\ \text{N}_2 \rightarrow h = 28820 \text{ KJ/Kmol} \end{array} \right\} \sum h_i h_{ip} = 5057934,5 \text{ KJ/Kmol } \text{C}_8\text{H}_{18}$$

Con 970 K

 $\text{CO}_2 \rightarrow h = 41145 \text{ KJ/Kmol}$ $\text{H}_2\text{O} \rightarrow h = 34653 \text{ KJ/Kmol}$ $\text{O}_2 \rightarrow h = 30345 \text{ KJ/Kmol}$ $\text{N}_2 \rightarrow h = 29157 \text{ KJ/Kmol}$

$$\left. \begin{array}{l} \text{CO}_2 \rightarrow h = 41145 \text{ KJ/Kmol} \\ \text{H}_2\text{O} \rightarrow h = 34653 \text{ KJ/Kmol} \\ \text{O}_2 \rightarrow h = 30345 \text{ KJ/Kmol} \\ \text{N}_2 \rightarrow h = 29157 \text{ KJ/Kmol} \end{array} \right\} \sum h_i h_{ip} = 5134467,5 \text{ KJ/Kmol } \text{C}_8\text{H}_{18}$$

Interpolación

900 $\rightarrow$ 5057934,5970 $\rightarrow$ 5134467,55074630 $\rightarrow$ 962

b) Con 400% aire teórico $T_p = 962 \text{ K}$